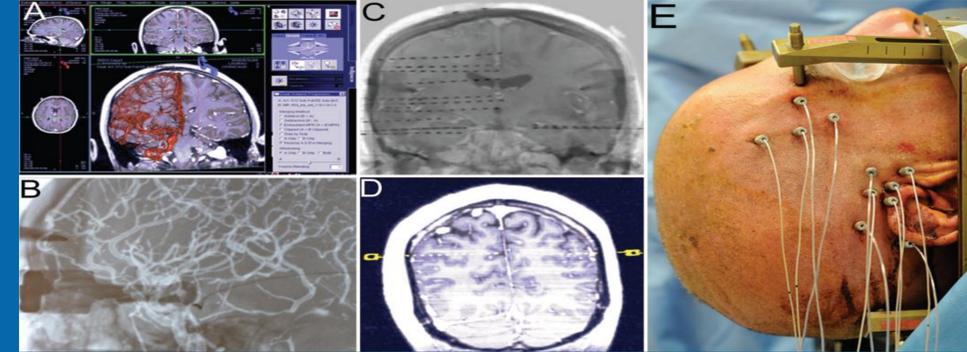


Anesthesia for intra-operative EEG monitoring for seizure focus detection (Stereoelectroencephalography) : A case series

Chakrabarti R, Pal R, Tewari A, Avitsian R

Department of Anesthesiology,
Cleveland Clinic Foundation, Cleveland, Ohio



Introduction:

SEEG is an emerging invasive diagnostic procedure for pre-surgical evaluation of drug resistant focal epilepsies to define epileptogenic zone (EZ)[1]. Anesthesia is a challenge when intra-operative EEG monitoring is done. Principles of anesthetic technique are described in this article along with experience of a wide number of cases which was done in our institute. Background: We did a retrospective anesthetic chart review covering all intra-operative EEG monitoring over last two years in our institute. The aim of this study was to obtain differences in anesthetic maintenance techniques employed by anesthesiologists.

Surgical technique:

In modern technique Dyna CT, MRI and angiography images are fused with dedicated fusion software .Stereotactic neuro navigation software is used to plan an avascular and precise trajectory for depth electrode implantation [2]. More recently a robotic arm is used for implantation. Calculated trajectories guide the robotic arm to precisely locate the point of drilling for implantation of probes [3].

Pre-operative assessment: Apart from routine pre-operative assessment, special emphasis should be given to antiepileptic medications and their possible effects on neuromuscular blockade and stopping of medications which could have effects on coagulation (Valproate,Aspirin, Clopidogrel).

Peri-operative monitoring: Minimal monitoring standard as per ASA and Invasive blood pressure monitoring after induction.

Anesthetic principle for Intra and post-operative management:

- Smooth induction and emergence: Remifentanil infusion from the beginning of induction and intubation after full muscle relaxation and should be a part of maintenance. Any sympathetic stimulation should be treated promptly with short acting beta blocker (Esmolol)

- Maintain adequate CPP

- To ensure absolute patient immobility: Rocuronium or Cis-atracurium were used for this purpose,a muscle relaxant infusion may be used to decrease the chance of patient movement

- To cause least interference with intra-operative EEG monitoring: This is achieved by concurrent Remifentanil infusion and 0.5 MAC of Volatile anesthetics and bringing down to lower MAC for actual recording.

- To enhance the chance of seizure detection: Low dose Ketamine infusion and very low MAC of volatile anesthetics helps to serve this purpose.

- Treatment of any complications: Post-operative seizure which is the main complication could be treated with bolus of Midazolam or Propofol ,fenta nyl and rocuronium.The surgery was completed without complication, the patient emerged from anesthesia quickly and after extubation .Post operative examination did not reveal any deficit.

Goals of Anesthetic management

1.	Smooth Induction and emergence
2.	Maintain adequate cerebral perfusion pressure
3.	To ensure absolute patient immobility
4.	To cause least interference with intra-operative EEG monitoring
5.	To enhance the chance of seizure detection
6.	Treatment of any complications

Methodology:

Institutional review board (IRB) approval was obtained and health insurance portability and accountability act standard was strictly followed for this retrospective study. We review the chart of all patients who undergone SEEG implantation and intra-operative EEG monitoring since January 2011 to December 2013.We excluded all pediatrics patients below 18 years.

Total patients	139
Age < 18 yrs	15
Age > 18 yrs	124
Male	54
Female	70



Results:

Midazolam Not used at beginning	41 (33.06) %	Midazolam used at the end before emergence	7 (5.65%)
Remifentanil Infusion	(Range: 0.02- 0.5 mcg/kg/ min)	+ 0.5 MAC Sevoflurane	101 (81.45 %)
Ketamine Infusion	+	0.5 MAC of sevoflurane:	7 (5.65%)
Intermittent rocuronium	+	1 MAC Sevoflurane :	16 (12.9%)

Discussion: Majority of the Anesthesiologist preferred Maintenance with Remifentanil infusion and low MAC. Midazolam was used at beginning in majority of cases. Ketamine infusion used as seizure foci enhancer in 7 cases and midazolam was used at the end where ketamine infusion is used.

Conclusion: A fine balance is required to provide balanced anesthesia while monitoring intra –operative EEG and this was achieved by



combination of intravenous and volatile technique. Synergistic effect of IV and Inhalational medication helps to keep the concentration of both low without affecting EEG monitoring while providing adequate anesthesia. Further structured study would be required to prove any role of seizure foci enhancers such as Ketamine.

References:

- 1.Ricardo Silva Centeno, Elza Márcia Targas Yacubian, Luis Otávio Sales Ferreira Caboclo, Henrique Carrete Júnior, Sérgio Cavalheiro1 Intracranial depth electrodes implantation in the era of image-guided surgery, Arq Neuropsiquiatr 2011;69(4):693-698
- 2.Jorge Gonzalez-Martinez, M.D, Ph.D,Jeffrey Mullin, M.D., M.B.A.,Sumeet Vadera, M.D,Juan Bulacio, M.D Gwyneth Hughes, M.D, Stephen Jones, M.D., Ph.D,Rei Enatsu, M.D, Ph.D,and Imad Najm , M.D. "Stereotactic placement of depth electrodes in medically intractable epilepsy" J Neurosurg 120:639–644, 2014